Report of ARLISS2006
- the come-back competition -

Tohoku University

Sekiguteam

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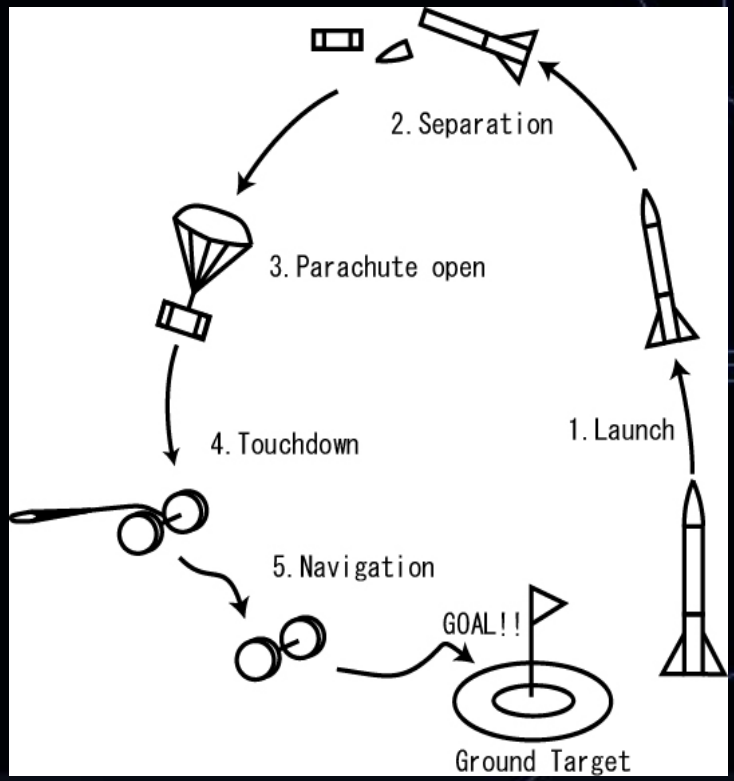
About ARLISS Competition

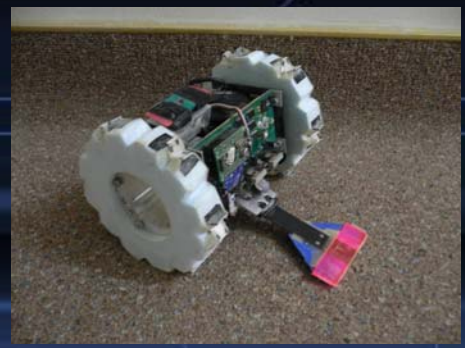
A Rocket Launch for International Student Satellite
(2006.9.20 ～ 21)

Black Rock Desert, Nevada, U.S

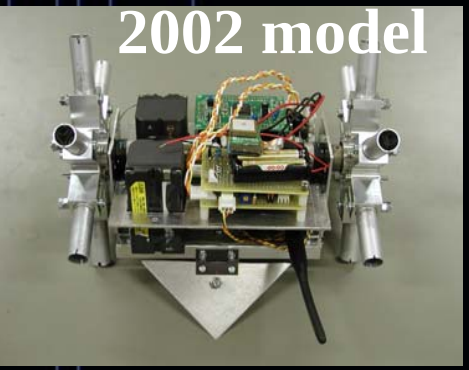


Rule

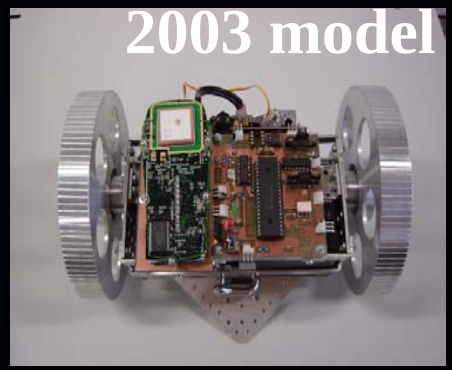
- **Weight : 1050 [g] or less**
- **Size : φ148 [mm], length 260 [mm] or less**



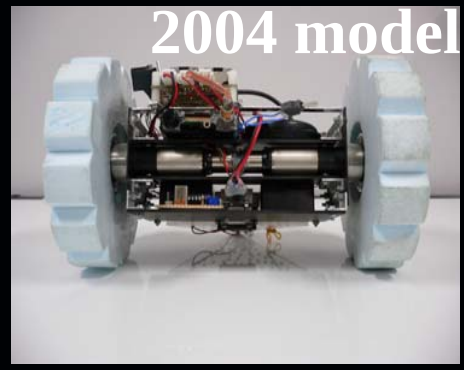
Aim of Our Team



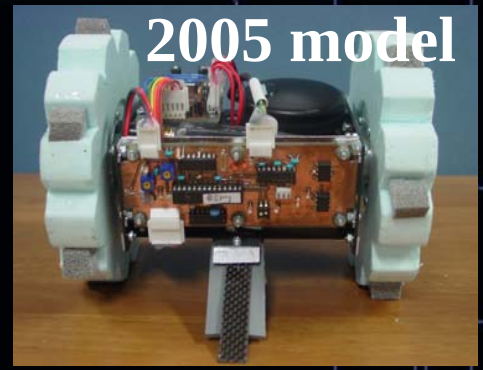
Didn't Open Parachute



Didn't Move After Landing



Didn't Open Parachute



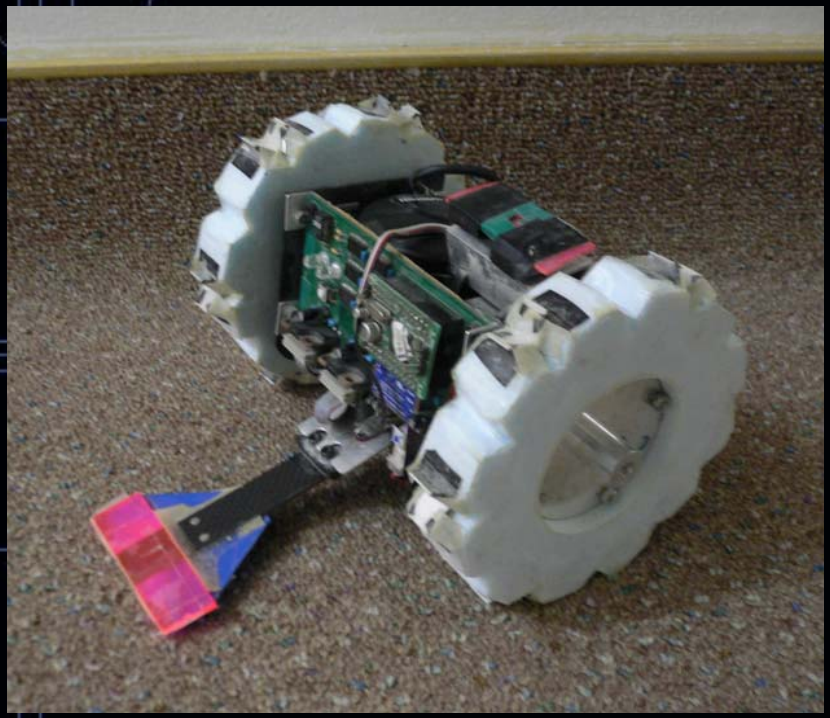
Won the First Prize
222 [m]

- Our laboratory has joined ARLISS since 2002.
- We gathered multiple experiment to improve our designs
- We won the first prize at ARLISS 2005.

Our Aim

Win the first prize and fulfill the condition of finishing within 50 [m] from the goal

Overview of Our Rover “KORIKI”



- Size：φ 130 [mm] × 185 [mm]
- Weight：1040 [g]

<Equipments>

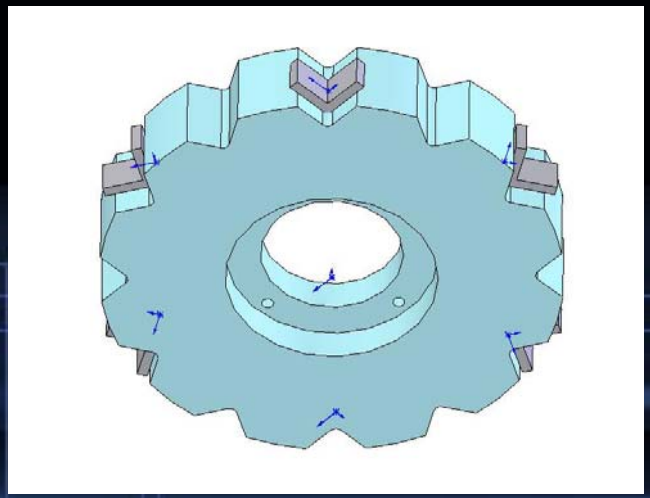
- Main MPU：H8/3694
- Motor：DC-Motor
- GPS
- Buttery：Lithium Ion
  (2040 [mAh])

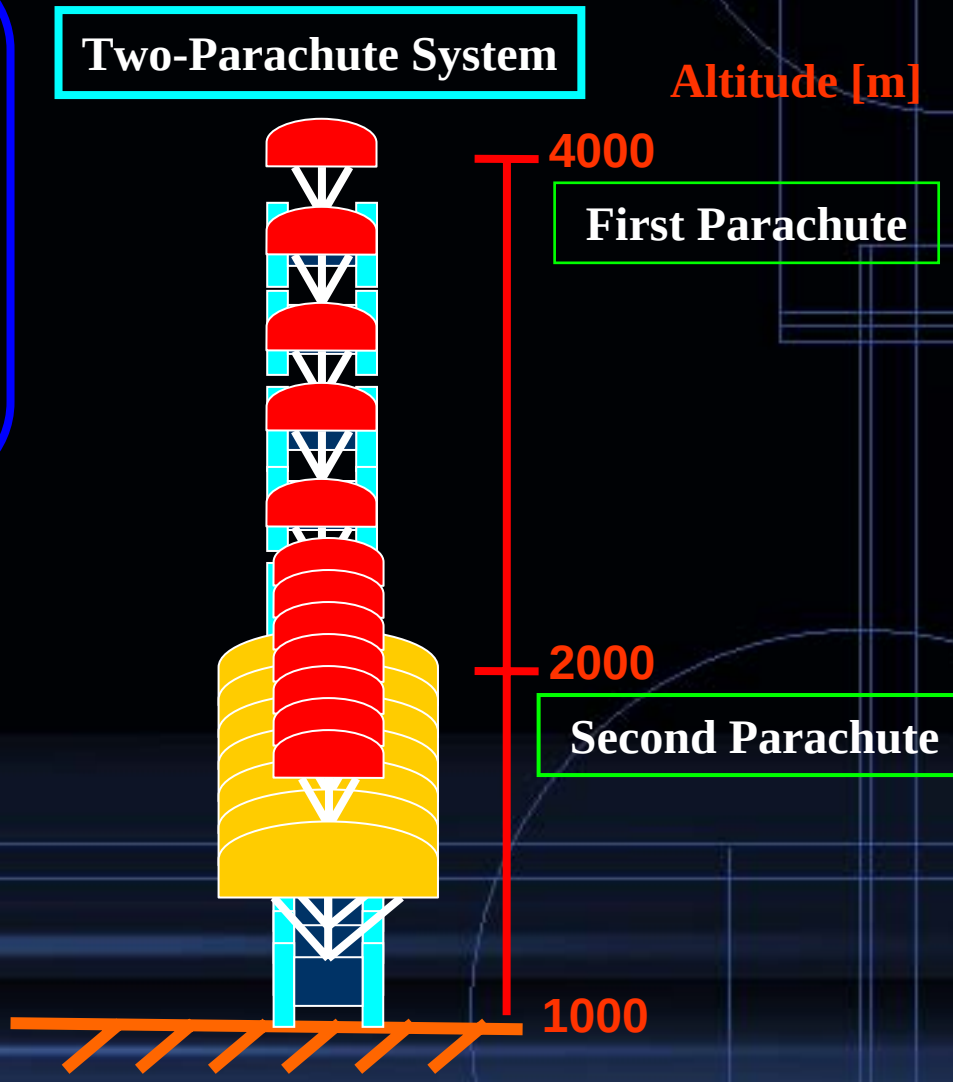
- Rover controls itself depending on GPS data
- Each wheel is controlled independently by motors

Mechanical Features

Mechanical Features

- Two-parachute system
- Wheels which have high traversability and less movement resistance
- Separation of the parachute with screw system

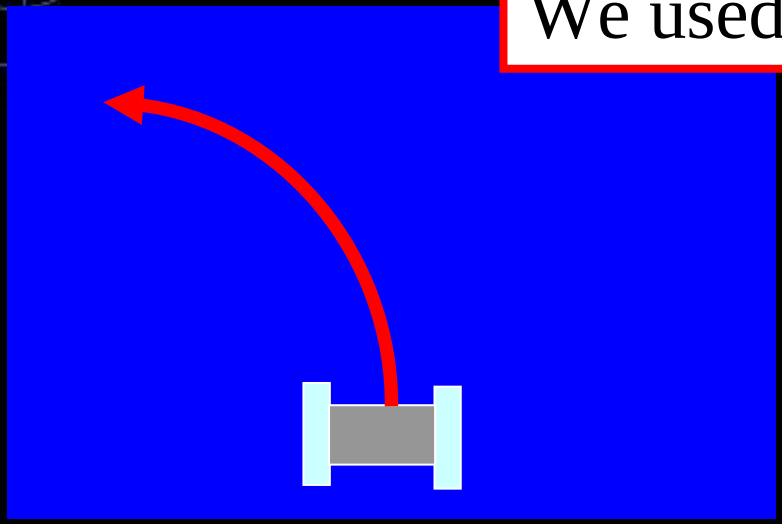




Mechanical Features

Navigation Algorithm

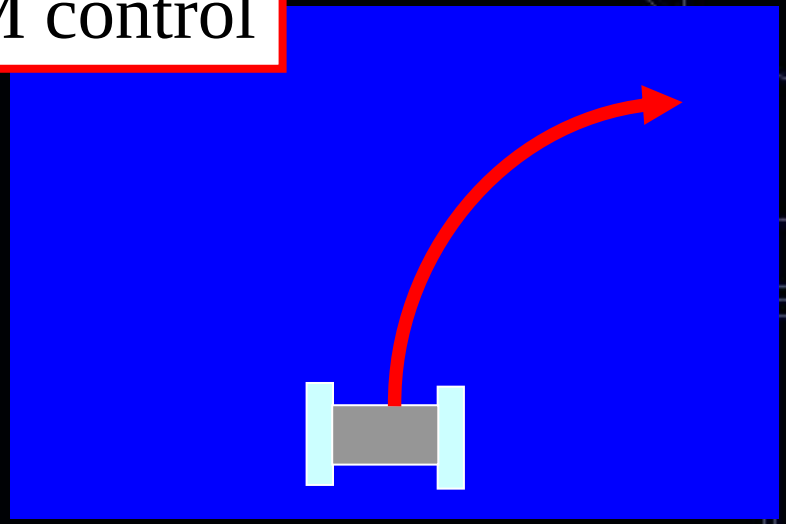
We used PWM control



When you want to Turn Left

$$RightWheel = DefaultDuty$$

$$LeftWheel = Duty$$
$$(Duty < DefaultDuty)$$



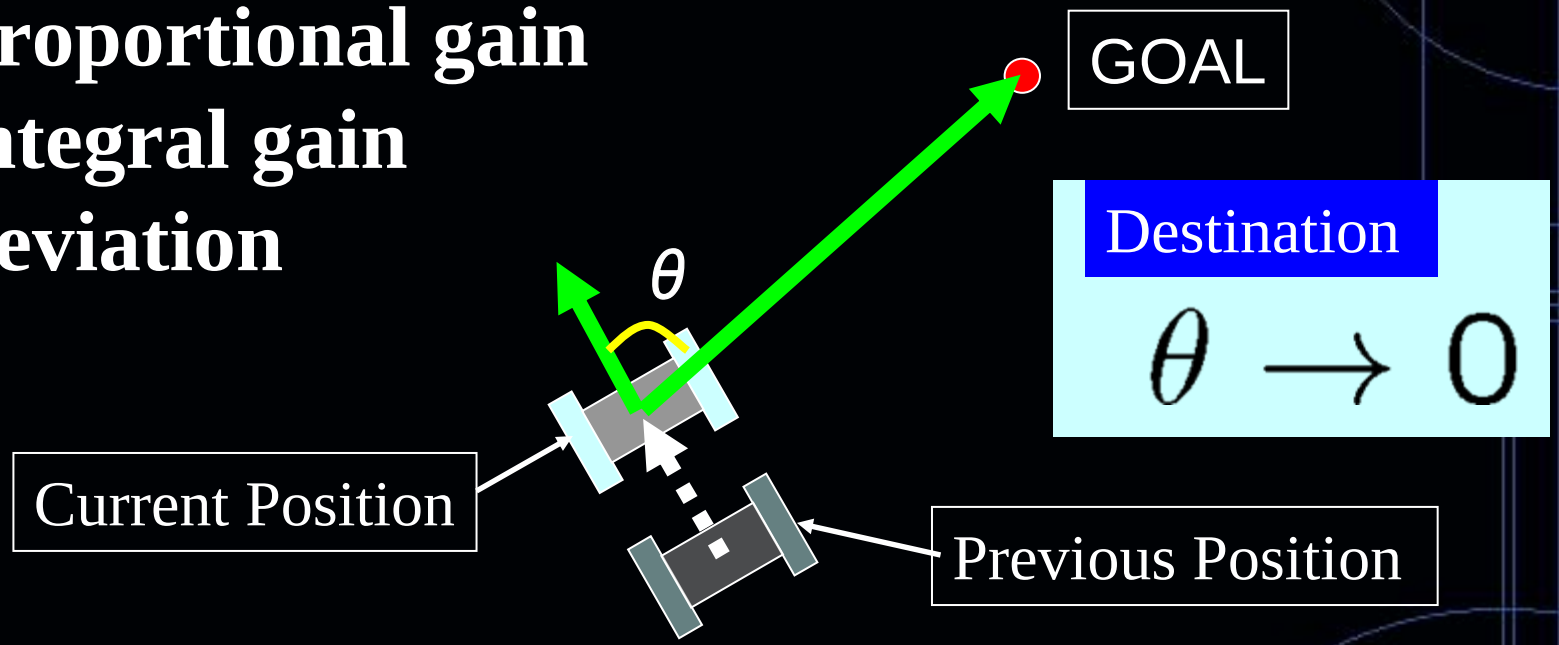
When you want to Turn Right

$$RightWheel = Duty$$
$$(Duty < DefaultDuty)$$

$$LeftWheel = DefaultDuty$$

Navigation Algorithm

K_P : Proportional gain
K_I : Integral gain
e_I : Deviation



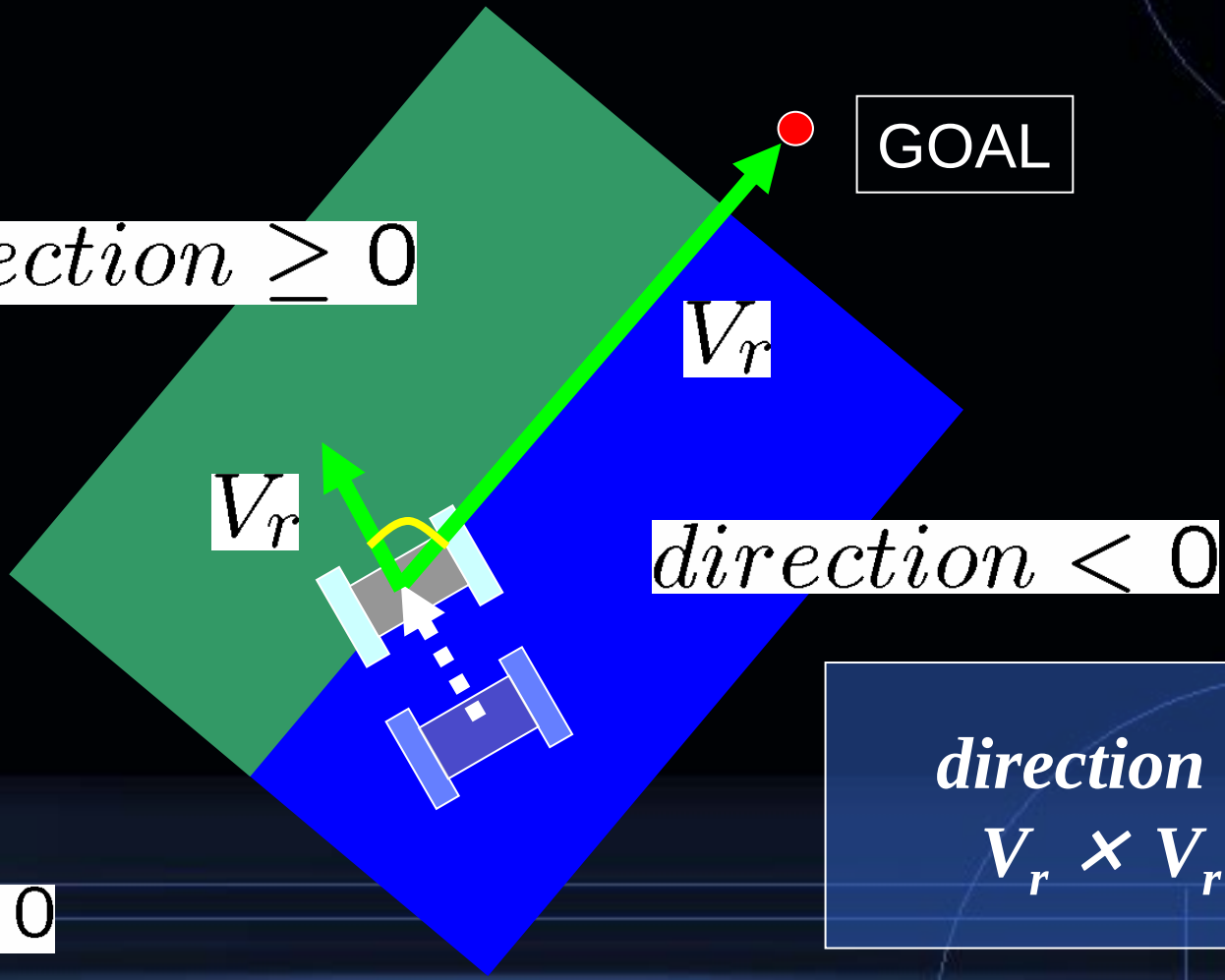
$\theta < \frac{\pi}{2}$

$$Duty = DefaultDuty - K_p * \sin\theta - K_i * e_i$$

$\theta \geq \frac{\pi}{2}$

$$Duty = DefaultDuty - K_p * (1 - \cos\theta) - K_i * e_i$$

Navigation Algorithm



For example…

$$\begin{cases} \theta \geq \frac{\pi}{2} \\ direction \geq 0 \end{cases}$$

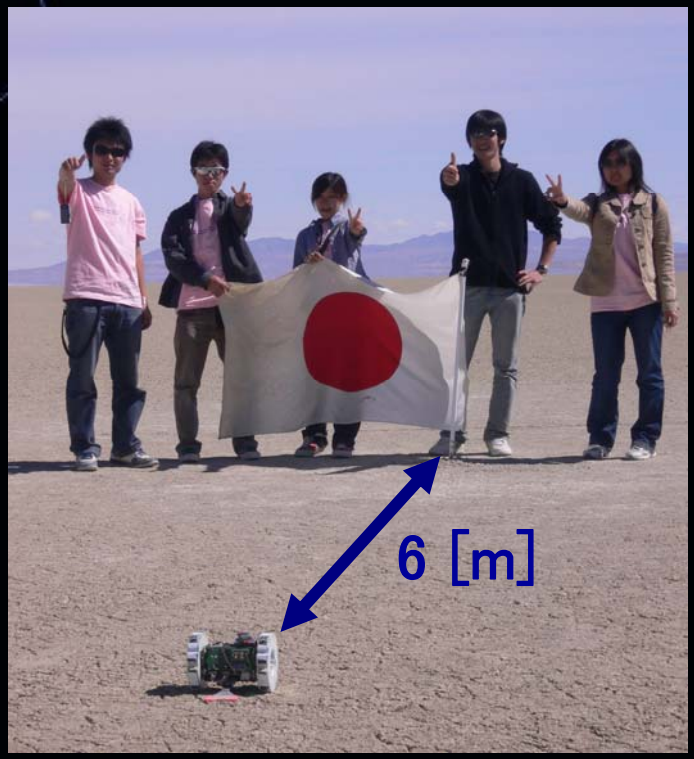
***direction* = $V_r \times V_r$**

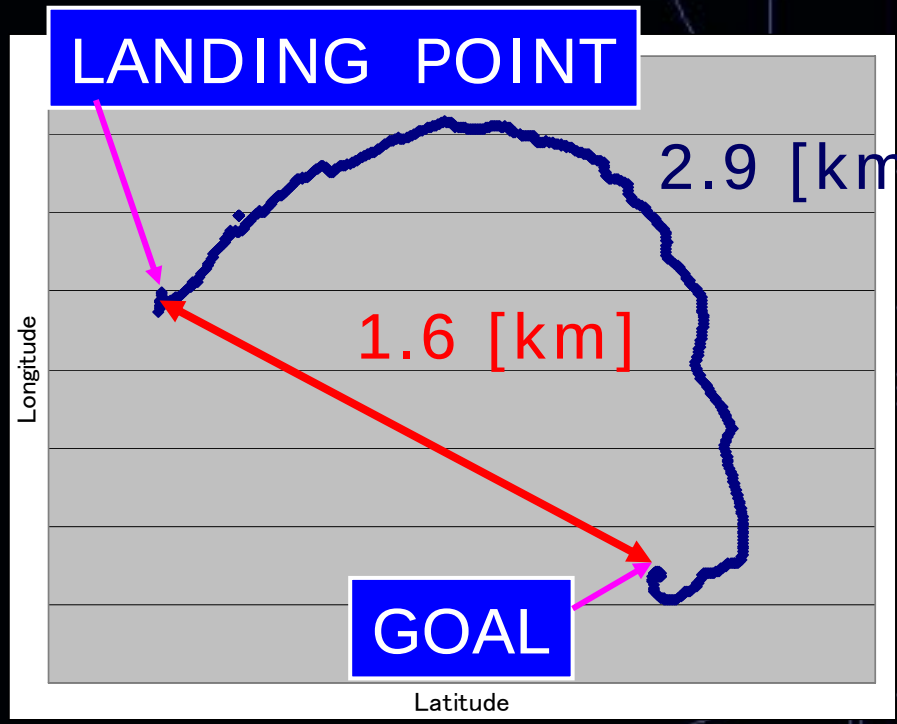
$$RightDuty = DefaultDuty - K_p * (1 - \cos\theta) - K_i * e_i$$

$$LeftDuty = DefaultDuty$$

Trial at ARLISS 2006

Results of ARLISS 2006



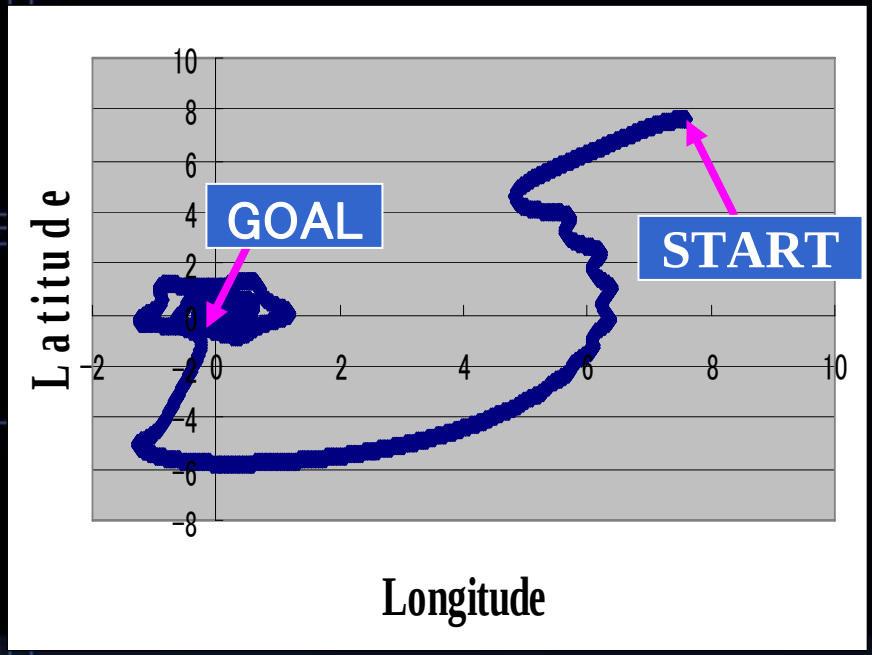


- Rover landed at 1.6 [km] away from the goal
- Rover advanced to left of the goal
- After 2.9 [km] of travel, rover stopped at 6 [m] away from the goal

Marked best record of ARLISS and fulfill the condition for goal

Additional Experiment

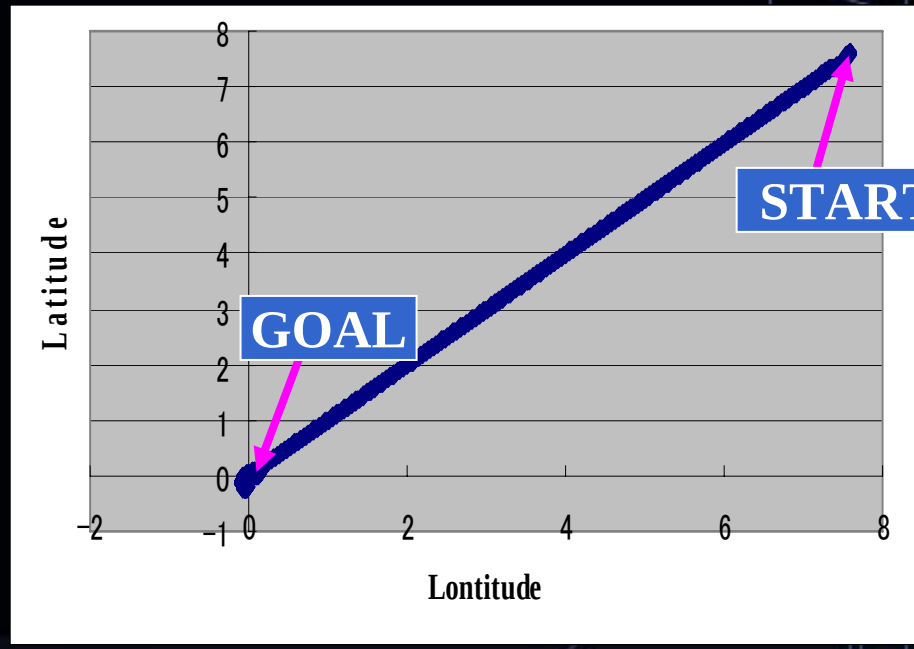
Algorithm used at ARLISS



$$-\frac{\pi}{2} < \theta < \frac{\pi}{2}$$

$$Duty = DefaultDuty - K_p * sin|\theta| - K_i * e_i$$

Fixed algorithm



$$-\frac{\pi}{2} < \theta < 0$$

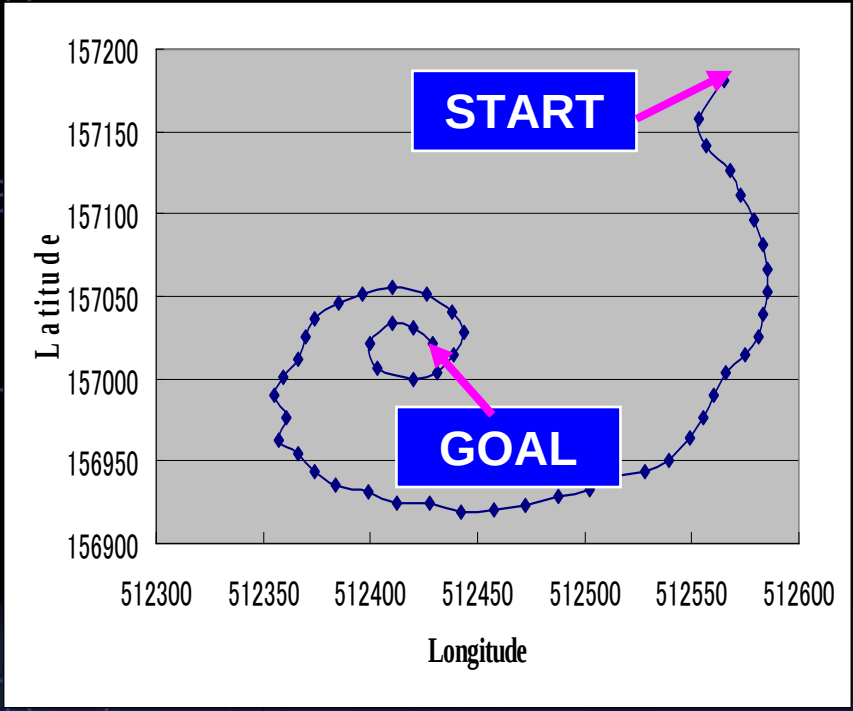
$$Duty = DefaultDuty + K_p * sin|\theta| - K_i * e_i$$

$$0 < \theta < \frac{\pi}{2}$$

$$Duty = DefaultDuty - K_p * sin|\theta| - K_i * e_i$$

Additional Experiment

Algorithm used at ARLISS



Fixed algorithm

The reason why our rover advanced to left of the goal at ARLISS was a software glitch

Conclusion

- **Our team decided to win the first prize and fulfill the condition of finishing within 50 [m] radius from the goal as a target.**
- **We developed the rover which has two wheels controlled depending on GPS data.**
- **We won the first prize and fulfilled the condition for the goal in ARLISS 2006.**
- **We did additional experiment and decided the reason why rover advanced to the left of the goal at the ARLISS competition.**

END